APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC - 2007 - 005

TITLE: Phoenix Spacecraft Lift on Pathfinder Rotation Fixture Strong Back

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PREPARED BY: Jack Dekker DATE: 5/3/07

REQUIRED APPROVAL

CONTRACTOR _____ DESIGN _____ R & QA _____ OPERATIONS _____ SAFETY

NASA _____ DESIGN _____ R & QA _____ OPERATIONS _____ SAFETY

TYPE OR PRINT NAME	SIGNATURE	ORG.	DATE
TIM GASPARRINI			3MAY07
THOMAS C McCAA			5/3/07
Fletcher Block			5-3-07
DONALD C LARSON			5-3-07
John C Dallberg	John C Dallberg	SA-C	5/9/07
JOE TORSANI		SA-B(LDEM)	14MAY07

CONTRACTOR DIRECTOR OF SAFETY

KSC FORM 20-200 NS (01/05)

Approval of the suspended load operations analyzed below is requested to support Phoenix processing at PHSF beginning 8 May 2007 through launch in August 2007. The suspended loads discussed below are scheduled to occur June 18-19, 2007.

Spacecraft crane lift on the Pathfinder Rotation Fixture strong back exposes personnel to suspended load hazard. A photo of the lift configuration taken during earlier MSP01 processing is provided in Figure 1. Personnel suspended load exposure occurs during the connection/ disconnection of the spacecraft to/from the receiving dolly and during spacecraft demate/mate from/to the Pathfinder Rotation Fixture strong back while the beam is suspended. Below is a hazard analysis of this lift per NASA-STD-8719.9 Appendix A.

Requirement A.4.1: The Phoenix spacecraft must be in the landed orientation to permit access to the cruise stage. The Phoenix spacecraft is shipped to KSC in the launch orientation. The Pathfinder Rotation Fixture is used to rotate the spacecraft between the launch and the landed orientations to permit required access. The Pathfinder Rotation Beam strong back (Figure 1) is a welded steel construction with an astroring interface that is capable of lifting Phoenix in the landed orientation. Four swivel hoist rings on the strong back provide lift points for a 4-legged sling. Disconnection/connection of the strong back to/from the rotation fixture frame can be accomplished with personnel to the side or above the load.

One of the two 50-ton PHSF highbay cranes will be used to lift the strong back with spacecraft from the Pathfinder Rotation Fixture frame to a dolly. The spacecraft will have three load limiter legs attached for interface with the dolly. The spacecraft must be guided to align the load limiter legs with inserts in the dolly, and personnel must torque fasteners at this interface. Three personnel are exposed to the suspended load during this mating process. The spacecraft is considered inadequate to hold the weight of the strong back if the load were lost even after the spacecraft itself is mated to the dolly. The strong back weighs approximately 750 pounds. The personnel exposure during this lift is limited by positioning personnel away from the load until hands-on control is needed to match load limiter leg holes to dolly inserts and torque fasteners to secure the spacecraft to the dolly. The suspended load hazard still exists from the strong back above the spacecraft, and personnel exit the zone of danger as these discrete tasks are completed.

Four personnel must also work under the shadow of the strong back to release and remove the clampband and guide the strong back mating surfaces apart as the strong back is removed. The launch vehicle interface is a highly critical separation interface. Damage to this interface could force postponement of launch if it affects the mate to the launch vehicle. The launch vehicle interface has some tight tolerance surfaces (+/-0.001 inches) that are extremely susceptible to nicks and dings. For these reasons, the launch vehicle interface demate process is a hands-on operation for the Phoenix program. The personnel exposure is minimized by clearing the technicians from the zone of danger after the strong back is lifted 2 inches above the spacecraft interface.

This lift must be reversed later to return the spacecraft to the launch orientation. The strong back is hoisted to the spacecraft, and four personnel enter the zone of danger

around the strong back to manually guide the astroring to the spacecraft launch vehicle interface. These four personnel attach the clampband to the interface to secure the spacecraft to the strong back. Three personnel must be in the zone of danger to disconnect the spacecraft from the dolly load limiter legs. Risk to personnel is minimized by clearing personnel from the zone of danger after the load limiter leg fasteners are removed.

Requirement A.4.2: Nominal processing at PHSF includes two spacecraft lifts with the Pathfinder Rotation Fixture strong back as follows:

1. From Pathfinder Rotation Fixture to load limiter legs on a dolly
2. From load limiter legs on a dolly to the Pathfinder Rotation Fixture

Off-nominal processing could require a repeat of the above operations, for instance, if a need arises to access the Phoenix science deck.

Requirement A.4.3: The first lift is scheduled 6/18/07. Performance of the lift is contingent on NASA Safety approval of the lift procedure and prior coordination with NASA Safety of operation start time.

Requirement A.4.4: This lift is performed in accordance with Pathfinder Rotation Fixture Operations Procedure PHX-SX-004. This procedure was submitted for KSC Safety review as a hazardous operation. The procedure is present and used at PHSF to perform these moves consistent with Lockheed Martin test discipline.

Requirement A.4.5: Phoenix spacecraft lift with the Pathfinder Rotation Fixture strong back will be performed in accordance with procedure steps in PHX-SX-004 approved by NASA Safety. If any changes to this hazardous procedure become necessary, NASA Safety must approve the changes before the operation continues.

Requirement A.4.6: PHSF facility management verified the PHSF cranes have been designed, tested, inspected, maintained, and operated in accordance with NASA STD 8719.9.

Requirement A.4.7: PHSF crane System Assurance Analyses for the East 50-ton bridge crane and West 50-ton bridge crane, SAA01HS11-005 basic and SAA01HS11-003 Rev B respectively, includes a Failure Modes and Effects Analysis, Critical Items List and a hazard analysis. There is no single failure point whose failure would result in dropping the load. Passive components such as rope drum, wire rope, and hook are verified through preventive maintenance. Total lifted mass for the strong back/spacecraft lift is approximately 2,200 lbs which is well within the PHSF cranes' capacity.

Requirement A.4.8: Pre-use inspection of the crane is completed within 24 hours before crane use. The need for crane pre-use inspection is coordinated with PHSF facility management, and completion of the inspection is verified before crane operations.

Requirement A.4.9: The crane operator remains at the crane controls at all times when the crane is suspending a load. Crane operators complete the Crane Operation Training Course provided by NASA training. Crane operators will carry two NASA certifications to support the load limiter lift. Either one of two cranes may be used for the load limiter lift: 1) 50-Ton West PHSF highbay crane, ID# CL600200; and 2) 50-Ton East PHSF highbay crane, ID# CL600300. The crane operators will carry their Crane Proficiency Demonstration Record validated by the NASA Examiner.

Requirement A.4.10: Nonessential personnel are kept clear of suspended load operations as noted in the procedure. Clear areas are established by highbay area announcement that non-essential personnel are to keep clear of the crane operation. A warning at the start of the hazardous operation addresses personnel to keep clear of the suspended load except for required tasks as described in Requirement A.4.1 of this SLOAA. The PHSF highbay is a limited access room that minimizes entry by personnel non-essential to the operation, and barriers are used to maintain the 25-foot clear zone specified in the procedure. Lockheed Martin Space Systems Company has instituted a stop command authority by any team member to halt an operation if conditions are observed that are hazardous to personnel or hardware.

Requirement A.4.11: The entire test team participates in a pre-task briefing immediately before the crane lifts as noted in the procedure. Included in the briefing are task assignments.

Requirement A.4.12: Voice communication is used and is adequate for all team members in these operations.

Requirement A.4.13: Phoenix size allows operator and signal person continuous line of site to personnel under the load.

Requirement A.4.14: All crane operations are hazardous operations that are coordinated with NASA Safety which provides opportunity for monitoring. The Phoenix operations may be considered closed as of 9/30/07. That allows for worst case contingencies of failure to launch including safing and preparation for ship.

Requirement A.4.15: The NASA Safety and Mission Assurance Division will provide copies of approved SLOAAs, a list of approved suspended load operations, a list of cranes/hoists used for suspended load operations and copies of the associated FMEA/CIL and hazards analyses to NASA Headquarters.

APPROVAL / DATE:

for Melanie J. Mulligan 5/1/07
Eddie Lebron
Program/Project S&MA Division Chief

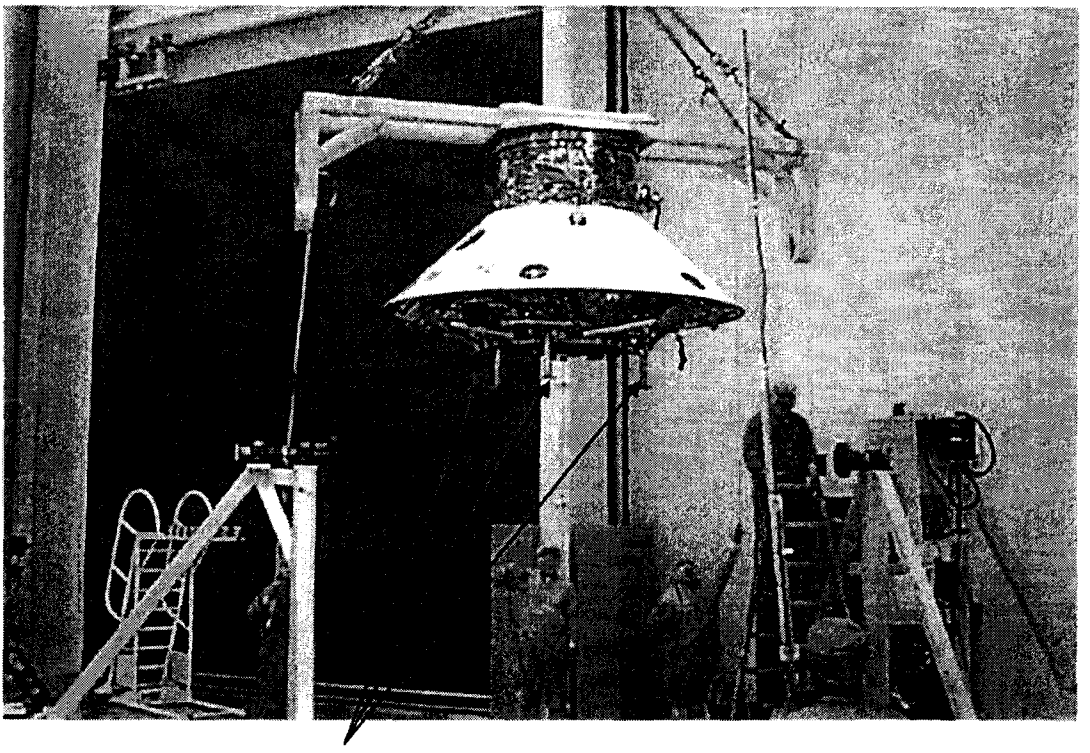

Figure 1: Pathfinder Rotation Beam with Spacecraft Lift Configuration